REMARKS

Claims 13-20 are pending. Claims 13-16 have been amended. New claims 17-20 have been added. No new matter has been introduced. Reexamination and reconsideration of the application are respectfully requested.

In the January 29, 2004 Final Office Action, the Examiner rejected claims 13-16 under 35 U.S.C. §112, first paragraph, as containing subject matter not described in the specification. The Examiner rejected claim 16 under 35 U.S.C. §112, second paragraph, as failing to set forth the subject matter which applicant regards as the invention. The Examiner rejected claims 13-16 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,018,507 to Takeda et al. ("the Takeda reference"). The Examiner rejected claims 13-16 under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,663,941 to Aoshima ("the Aoshima reference") considered with the Takeda reference. The Examiner rejected claim 13 under 35 U.S.C. §102(b) as being anticipated by EP 303936 ("the '936 reference") or U.S. Patent No. 5,475,662 to Miyagawa et al. ("the Miyagawa reference"). These rejections are respectfully traversed.

The present invention relates to a method and system of recording information on an optical disk utilizing a mark-length recording scheme. Tracking control is performed using tracking error signals detected during an OFF period and a rear time segment within an ON period of a recording pulse signal. The time segment for detecting the tracking error signal within the recording pulse ON period is variably controlled in accordance with recording conditions, such as a disk type and recording speed. Tracking control during recording is conducted using a tracking offset value that

is continuously calculated and corresponds to a tracking offset amount such that pit forming efficiencies of an inner and outer circumference side of the track are balanced and center lines of both the pit and the track are substantially coincident.

The Examiner rejected claims 13-16 under 35 U.S.C. §112, first paragraph, alleging that there is not adequate support for the limitation "pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are to be balanced" in the specification as originally filed.

A fundamental problem that the present invention addresses is that pits tend to be formed off a center line of a track even when a laser light beam is irradiated with a center of the laser light beam optical axis accurately positioned at the track center line due to the influence of residual heat from an adjoining track.

With reference to FIG. 6, the specification of the present application states "photo detector 48 comprises a quadruple PIN photo diode which forms the light-receiving elements for receiving reflections of the laser light 20 from the optical disk 10. The following description is made in relation to a case where the tracking control is performed using the known push-pull method. Reflected light reception signals **A** and **D**, output from <u>the two light-receiving elements for receiving the reflections from inner portions of the currently-recorded track</u>, are added together to be sent to the sample and hold circuit 38 as an **"A+D" reflected light reception signal**. Similarly, reflected light reception signals **B** and **C**, output from t<u>he other two light-receiving elements for receiving the reflections from outer portions of the currently-recorded track</u>, are added together to be sent to the sample and hold circuit 38 as a **"B+C" reflected light reception signal.**" (Page 22, lines 7-23, emphasis added in bold and underscoring).

The specification further states "the two output signals from the sample and hold circuit 38 are given to a subtracter 54, constituting the above-mentioned tracking-error detecting circuit 40, which determines a difference between the output signals to thereby generate **a tracking error signal ("B+C"-"A+D")**." (Page 23, lines 6-11, emphasis added in bold)

The specification further states "if the recording is effected with the influence of the residual heat left unremoved, **a portion of a pit, closer to the inner edge of the currently-recorded track, is formed more efficiently, so that a reflection from that inner portion of the pit** (*"A+D" reflected light reception signal*) **will have a reduced light amount** as denoted by a dotted-line curve in section (b) of Fig. 4. Thus, even when the optical axis of the laser light remains positioned on the center line of the track, there would be caused a significant difference in light amount between the reflection from the inner portion of the track (*"A+D" reflected light reception signal*) and the reflection from the outer portion of the track (*"B+C" reflected light reception signal)* as denoted by a solid-line curve in section (b) of Fig. 4, which would lead to an increased level of the tracking error signal." (Page 7, line 27-page 8, line 12, with emphasis added in bold and annotations added in italics). Applicant respectfully submits that one skilled in the art would ascertain that the "**pit forming efficiency**" may be measured by the reflectance of light from a thus formed pit using a photodetector.

The specification further states "the reflected light reception signals are also sent to a tracking signal generating circuit 36. In the tracking signal generating circuit 36, a sample and hold circuit 38 extracts respective appropriate segments of the signals, a tracking-error detecting circuit 40 detects a tracking error on the basis of the extracted

segments to provide a tracking error signal, and the tracking error signal is then smoothed by a low-pass filter 42 to generate a tracking signal. The tracking signal is fed to servo circuit 44, comprising for example a digital servo circuit, which performs tracking control by driving a tracking actuator within the optical head 32 in such a manner that **the absolute value of the tracking signal decreases**." (Page 21, lines 10-24, emphasis added in bold)

The specification further states "the "A+D" and "B+C" light signals assume waveforms as shown in section (Se), from which it will be seen that when influenced by residual heat from an adjoining track inward of the currently-recorded track, the "A+D" or inner reflected light reception signal (denoted in dotted line) in an ON period of the recording pulse signal becomes lower in level than the "B+C" or outer reflected light reception signal (denoted in solid line)." (Page 24, lines 6-17)

The specification further states "the servo circuit 44 is controlled to find **a particular point where a minimum absolute value of the tracking signal ("B+C"- "A+D") is obtained**; more specifically, the servo circuit 44 constantly monitors relation between a direction of radial displacement of the laser light beam 20 relative to the optical disk surface and the increase/decrease in the absolute value of the tracking signal ("B+C"- "A+D"), so as to shift the laser light beam 20, radially of the optical disk, in such a direction where the **absolute value of the tracking signal is minimized.** Thus, the laser light beam 20 is shifted radially outward relative to the track center line 28, so as to **minimize the level of the tracking signal ("B+C"- "A+D")**. As the laser light beam 20 is shifted radially outward, the influence of the residual heat from the adjoining inner track decreases and accordingly the level of the "A+D" reflected light

reception signal increases, so that the tracking signal ("B+C" – "A+D") assumes a smaller value. However, as the laser light beam 20 is shifted closer to the outer circumference of the optical disk, the level of the "B+C" signal becomes gradually greater due to a tracking error while the ratio, of the level increase amount of the "A+D" signal, to the outward shift amount of the laser light beam 20 becomes gradually smaller. Accordingly, the level of the tracking signal ("B+C" – "A+D") turns, at a particular point, from a decreasing path to an increasing path. Thus, the servo circuit 44 causes the laser light beams 20 to be placed in such an offset position as to achieve a minimized level of the tracking signal ("B+C" – "A+D"). Here, the offset amount of the laser light beam 20 is varied depending on the length of the ON-period segment of the recording pulse signal that is to be incorporated into the sampling time. Accordingly, by setting an appropriate length of the ON-period segment of the recording pulse signal (i.e., by modifying the rising timing of the sampling pulse), a pit can be formed accurately on and along the center line of the recording track." (Page 27, line 13, to page 28, line 23, emphasis added in bold).

Applicant respectfully submits that the specification states that the tracking signal is represented by ("B+C" – "A+D"). The specification states that "with the influence of the residual heat left unremoved, **a portion of a pit, closer to the inner edge of the currently-recorded track, is formed more efficiently, so that a reflection from that inner portion of the pit** ("A+D" reflected light reception signal) **will have a reduced light amount**". Therefore, one skilled in the art would understand that the "pit forming efficiency" may be measured by the reflectance of light from a thus formed pit using a photodetector. Applicant respectfully submits that the specification teaches that the

"A+D" reflected light reception signal represents reflected light reception signals A and D, output from the two light-receiving elements for receiving the reflections from inner portions of the currently-recorded track, and "B+C" reflected light reception signal represents reflected light reception signals B and C, output from the two light-receiving elements for receiving the reflections from outer portions of the currently-recorded track. Applicant respectfully submits that the specification states "the servo circuit 44 constantly monitors relation between a direction of radial displacement of the laser light beam 20 relative to the optical disk surface and the increase/decrease in the absolute value of the tracking signal ("B+C"- "A+D"), so as to shift the laser light beam 20, radially of the optical disk, in such a direction where the **absolute value of the tracking signal is minimized**". Applicant respectfully submits that one skilled in the art would understand that the absolute value of the tracking signal can take on **a minimum value of zero when "B+C" = "A+D"**.

With reference to FIG 11, Applicant respectfully submits that the specification shows that that <u>the tracking signal does take on such a minimum value of zero</u>. Applicant respectfully submits that one skilled in the art would understand that the absolute value of the tracking signal takes on a minimum value of zero when "B+C" = "A+D" because the **pit forming efficiencies,** as measured by light reflectance, of the inner ("A+D" reflected light reception signal) and outer ("B+C" reflected light reception signal) circumference sides of the track relative to the offset light beam **are balanced** (i.e., the absolute value of the tracking signal takes on a minimum value of zero when "B+C" = "A+D"). Therefore, Applicants respectfully submit that the specification adequately supports claims 13-16 as written. Furthermore, Applicants have amended

the specification to clarify this point and no new matter has been introduced.

Independent claim 13, as amended, recites:

An optical disk method for recording information on an optical disk, based on a mark-length recording scheme, comprising:

forming pits sequentially from an inner circumference to an outer circumference of the optical disk by a light beam irradiated onto a track formed as a groove or land on a recording surface of the optical disk; and

performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**.

The Examiner rejected claims 13-16 under 35 U.S.C. §102(e) as being anticipated by the Takeda reference. The Examiner rejected claims 13-16 under 35 U.S.C. §103(a) as being obvious over the Aoshima reference considered with the Takeda reference. The Examiner rejected claim 13 under 35 U.S.C. §102(b) as being anticipated by EP 303936 or the Miyagawa reference.

The Takeda reference does not disclose, teach, or suggest the method of independent claim 13, as amended. Unlike independent claim 13, as amended, the Takeda reference does not show "performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer

circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**."

The Takeda reference states that "the target value setting and changing circuit 20 has a function which, in reproduction, sets the target value of the tracking servo to be "0" so that the tracking servo may work in the ontrack mode, and **in recording, sets the target value of the tracking servo to be "+ alpha."** so that the tracking servo may work in the detrack mode, thus altering the setting of the target value of the tracking servo. Regarding the target value, **a value which was found in advance by an experiment based on the optical system**, the pit width on the recording thin film and the track pitch is set up as the initial target value. The detrack amount is set so that the edge portion of the track width in the direction toward the internal circumference of the disk **may coincide with the circumference portion of a light beam spot which is formed by irradiating the laser beam on a track** and which is effective upon the recording, in the direction toward the internal circumference of the disk." (Col. 10, line 64 to col. 11, line13).

The Takeda reference also states that "the light beam is offset by a **detrack-offset amount** to a track side in the direction of recording by a target value setting/altering means so that an **edge of the diameter of the light beam spot in the direction toward the internal circumference of the recording medium may coincide with an edge of the first track or the second track in the direction toward the internal circumference of the recording medium**. Accordingly, a portion which sticks out into the track on the side of the external circumference of the recording

medium will be subjected to the erasing operation and erased thereby, or overwritten by the overwriting operation to form the record mark on the stuck portion, thereby allowing the first record mark and the second record mark to be formed in the effective track width of the first track or the second track." (Col. 5, lines 22-29).

In other words, during recording, the target value setting and changing circuit 20 sets the target value or "detrack-offset amount" of the tracking servo to be "+ alpha." The target value or "detrack-offset amount" is a **predetermined value found in advance by an experiment**. During recording, the target value or "detrack-offset amount" is not changed, the target value is not "continuously calculated". Using the predetermined target value or "detrack-offset amount" equal to a fixed predetermined value "+ alpha" , the light beam is offset by the detrack-offset amount to a track side in the direction of recording by a target value setting/altering means so that an edge of the diameter of the light beam spot in the direction toward the internal circumference of the recording medium may coincide with an edge of the first track or the second track in the direction toward the internal circumference of the recording medium.

Furthermore, Takeda reference makes no mention of "the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced." The Takeda reference simply teaches that the light beam is offset by the predetermined detrack-offset amount to a track side in the direction of recording by a target value setting/altering means so that an edge of the diameter of the light beam spot in the direction toward the internal circumference of the recording medium may coincide with an edge of the first track or the second track in the direction toward the internal

circumference of the recording medium.

The Aoshima reference does not make up for the deficiencies of the Takeda reference. As stated by the Examiner, "Aoshima discloses an optical recording and reproducing system wherein although tracking control is performed, there is no offset ability for such. The Aoshima reference does not disclose, teach, or suggest the method of independent claim 13, as amended. Unlike independent claim 13, as amended, the Aoshima reference does not show "performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**"

The EP 303936 or the Miyagawa references do not disclose, teach, or suggest the method of independent claim 13, as amended. Unlike independent claim 13, as amended, the EP 303936 or the Miyagawa references do not show "performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**".

The EP 303936 reference is directed to minimizing the effects of writing pulses used in a recording operation on tracking error detection (TR) utilizing extracting pulses that have a pulse width equal to a writing pulse width. The EP 303936 reference states

"the track offset ΔTR is eliminated as shown in Fig. 3(f), and the stability of the TR servo system in the write mode can be greatly improved." (Col. 6, lines 13-16.) The EP 303936 reference also states "In order to minimize such a track offset appearing during the information recording operation, the present invention provides means for extracting, from the TR detection system, the writing pulse parts which are the source of occurrence of the track offset. " (Col. 5, lines 15-20.)

The EP 303936 reference makes no mention whatsoever of "performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**".

The Miyagawa reference is directed to an optical disc apparatus, which uses an optical disc having a signal recorded on **both** <u>hollow</u> and <u>convex</u> portions of tracks, provides stable tracking control. An offset judging circuit judges whether the signal <u>has been recorded only on either of two recording regions</u> adjacent in a vertical direction to the track direction. An offset application circuit <u>applies an **offset voltage** to an error signal on the basis</u> of a control signal output in accordance with the result of the offset judging means. This effectively cancels an offset in the tracking error signal caused by the existence of recording pits only on an inner circumference side or outer circumference side of an adjacent recording track to provide stable tracking control. The **offset voltage is a predetermined fixed voltage**. The Miyagawa reference states "Here, the V1 and V2 are previously set to be equal to offset voltages of the tracking

error signal when the recording marks exist only on the adjacent recording track on the inner circumference side or the outer circumference side. This provides that the error signal E2 cancels the offset due to existence of the recording marks only on the adjacent recording track on the inner circumference side or the outer circumference side. The V1 and V2 can be previously obtained through the following steps for example." (Col. 11, lines 44-51.)

The Miyagawa reference makes no mention whatsoever of "performing tracking control, during said step of forming pits, by offsetting a center of an optical axis of the light beam, **by a continuously calculated amount**, from a center line of the track toward the outer circumference of the optical disk, **the continuously calculated amount being such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are balanced**".

Any combination of the above references does not disclose, teach, or suggest the method of independent claim 13, as amended.

Independent claims 14-16, as amended, recites limitations similar to independent claim 13, as amended. Specifically, independent claims 14-16, as amended, recite "said tracking error signal having a tracking offset value continuously calculated and corresponding to a tracking offset amount such that pit forming efficiencies of the inner and outer circumference sides of the track relative to the offset light beam are to be balanced". Accordingly, Applicant respectfully submits that independent claims 14-16, as amended, distinguish over the above-cited references for the reasons set forth above with respect to independent claim 13, as amended.

In addition, any combination of the above references does not disclose, teach, or

suggest "a tracking signal generating section that outputs the tracking error signal by continuously detecting a reflected light reception signal resulting from the tracking error signal during a particular period from a given time point to a subsequent time point, wherein the given time point is within a recording signal ON period, after formation of a pit is initiated in response to turning on a recording pulse signal, and after a reflection of the light beam from the optical disk passes a peak level, wherein the subsequent time point is within a recording signal OFF period and before the recording pulse signal is next turned on, and during an other period other than said particular period, by holding a level of the tracking error signal detected immediately before said other period, or outputting a zero-level tracking error signal as a tracking signal" as recited in independent claims 14-16, as amended. Accordingly, Applicant respectfully submits that independent claims 14-16, as amended, distinguish over the above-cited references for this reason as well.

New claims 17-20 have been added to further define Applicant's invention. New claims 17-20 recite limitations similar to independent claim 13, as amended. Accordingly, Applicant respectfully submits that new claims 17-20 distinguish over the above-cited references for the reasons set forth above with respect to independent claim 13, as amended.

Applicant believes that the foregoing amendment and remarks place the application in condition for allowance, and a favorable action is respectfully requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles telephone number (213) 488-7100 to discuss the steps necessary for placing

the application in condition for allowance should the examiner believe that such a telephone conference would advance prosecution of the application.

Respectfully submitted,

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